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Communication engineering
Electromagnetic waves First exam

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duration 60 min

- Q1) a) What is a TEM wave (7 marks)
b) what is meant by polarization of a plane wave
c) Define propagation constant, attenuation constant, and phase constant
d) What is meant by skin depth
e) Define pointing vector and state pointing theorem
f) What is a standing wave

Q2) Assuming that the sea water have $\sigma=4 \text{ S/m}$, $\epsilon_r=80$, $\mu_r=1$. The magnetic field intensity of a linearly polarized uniform plane wave propagating in $+y$ direction is given by:

$H(0,t) = \hat{a}_y 0.1 \sin(10^{10} \pi t - \pi/3) \text{ (A/m)}$ at $y=0$

- a) Calculate the phase velocity b) the wave length c) the skin depth d) the intrinsic impedance
e) write the expression of $E(y,t)$, $H(y,t)$ at $(0,t)$ and at $(1m,t)$
f) find the distance at which the electric field is 5% of its value at $y=0$.

$H(y,t)$

Q3) Given a uniform plane wave in air (8 marks)

$E_i = 40 \cos(\omega t - \beta z) \hat{a}_x - 30 \sin(\omega t - \beta z) \hat{a}_y \text{ (V/m)}$

- a) Write the expression for H_i
b) If the wave encounters a perfectly conducting plate normal to the z -axis at $z=0$ find the reflected waves E_r , H_r
c) What are the total E & H fields for $z \leq 0$
d) What are time average pointing vectors for $z \leq 0$ and $z \geq 0$

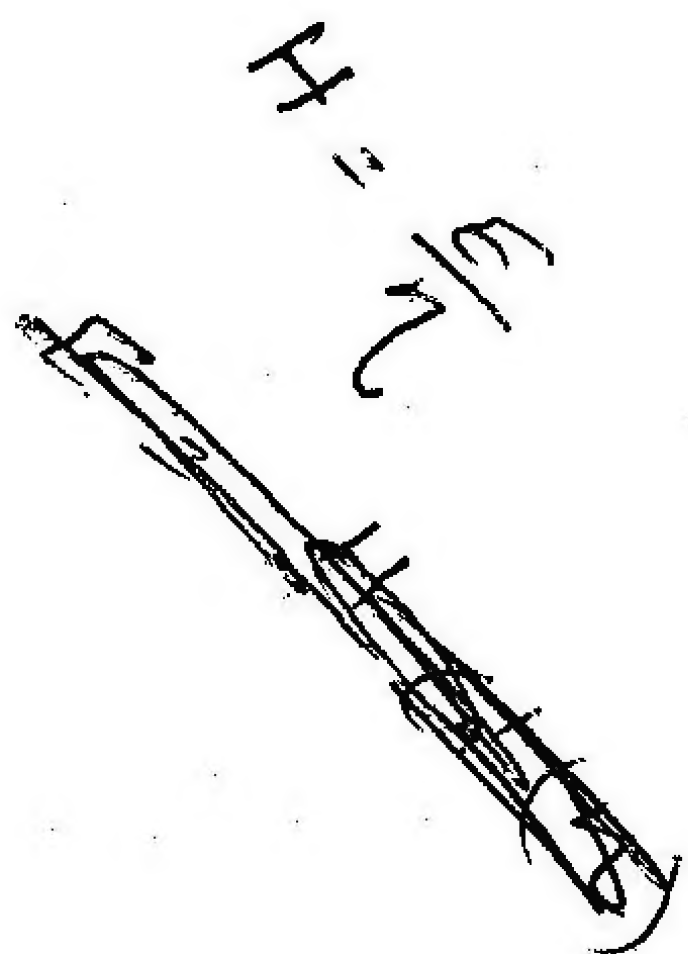
Q4) A plane wave in a non magnetic media has an electric field

(5 marks) $\mu_r = 1$

$E = 50 \sin(10^8 t + 2z) \hat{a}_y \text{ v/m}$

Find

- a) H b) wave length and ϵ_r c) What is the direction of propagation



Good luck
Mahmoud Ahmad

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